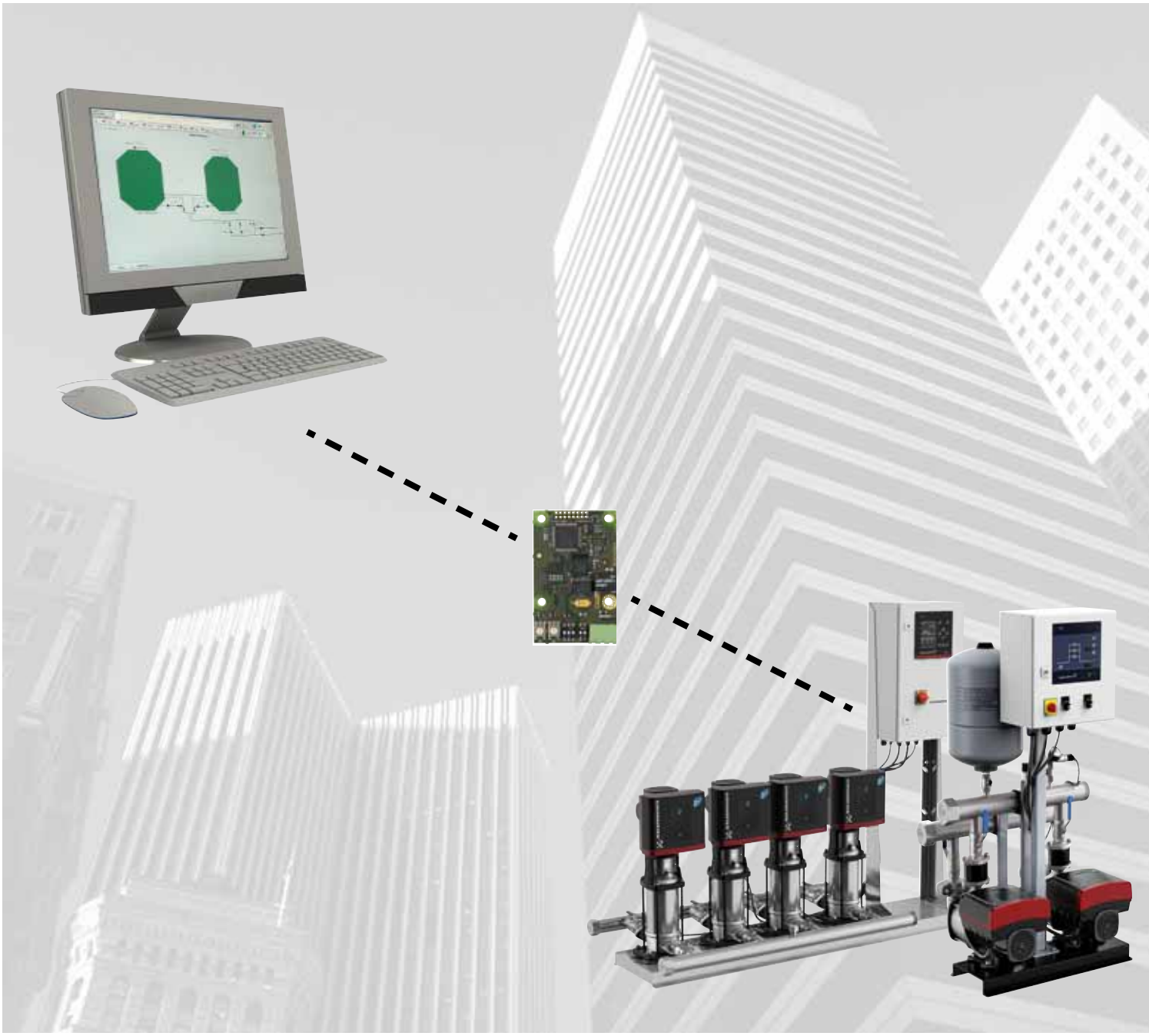
LONworks for Grundfos Boosters

CIM/CIU 110

Functional profile and user manual



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Original functional profile and user manual.

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1. Symbols used in this document

Caution — If these safety instructions are not observed, it may result in malfunction or damage to the equipment.

Note — Notes or instructions that make the job easier and ensure safe operation.

2. Introduction

2.1 About this functional profile

This functional profile describes the CIM 110 and CIU 110 for LON communication with the following Grundfos booster systems:

- Grundfos Hydro Multi-B (CU 323)
  Hydro Multi-B is a complete booster system incorporating Grundfos CM/CME pumps.
- Grundfos Hydro MPC (CU 352)
  Hydro MPC is a complete booster system incorporating Grundfos CRE pumps.
- Grundfos Control MPC (CU 352)
  Control MPC can be built with different pump types to form a booster system.
- Grundfos Multi-E
  A booster set based on Grundfos MGE pumps model H and later.
- Grundfos TPED twin-head pump with MGE motor, model H/I, in multipump-mode (CIM 110 must be in the master pump head).
- MAGNA3 Twinpump in multipump mode
  Requires a CIM110 module installed in the master pump.

The CIU 110 incorporates a CIM 110 (LON Communication Interface Module 110).

References in the following:

- The CIM 110 module is referred to as "LON module".
- The Hydro Multi-B, Hydro MPC, Multi-E and Control MPC are referred to as "controller".
  Control MPC and Hydro MPC are referred to as "Hydro MPC".

The data in this document are subject to change without prior notice. Grundfos cannot be held responsible for any problems caused directly or indirectly by using information in this functional profile.

2.2 Assumptions

This functional profile assumes that the reader is familiar with commissioning and programming LON devices. The reader should also have some basic knowledge of the anatomy of LON data communication.

2.3 Definitions and abbreviations

CIM 110	Communication Interface Module 110
CIU 110	Communication Interface Unit 110
CP	Configuration Property
CU 323	Grundfos Control Unit 323
CU 351	Grundfos Control Unit 351
CU 352	Grundfos Control Unit 352. Used for multipump systems.
CU 35x	CU 351 and CU 352
DRF	Device Resource Files
GENIbus	Proprietary Grundfos fieldbus standard
Grundfos GO	Grundfos remote control
H	Head (pressure)
LED	Light-Emitting Diode
LON	Local Operating Network
MGE	Electronic Grundfos Motor
MPC	Multi-Pump Controller
nci	Network configuration property Input
nv	Network variable
nvi	Network variable input
nvo	Network variable output
Q	Flow rate
R100	Grundfos remote control
SCPT	Standard Configuration Property Type
SNVT	Standard Network Variable Type
UCPT	User-defined Configuration Property Type
UFPT	User-defined Functional Profile Type
UNVT	User-defined Network Variable Type

2.4 System diagram

The system diagram gives an overview of how to connect the CIM/CIU 110 to the Grundfos booster system that is to be connected to a LON network.

CIM 110 solution

The CIM 110 is an add-on communication interface to be fitted directly into the following products:

- Grundfos CU 352 Hydro MPC
- Grundfos CU 352 Control MPC
- Grundfos CU 323 Multi-B
- Grundfos Multi-E (MGE model H and later)
- MAGNA3 Twinpump in multipump mode
  Requires a CIM110 module installed in the master pump.

In all cases, the booster system will supply power to the CIM 110 module. See example in fig. 1.

The Hydro Multi-B controls and monitors a number of pumps (2 to 4).

CIU 110 solution

The CIU 110 is an external box with a power supply module and a CIM 110 inside. It can be mounted on a DIN rail or on a wall. See fig. 2.

Communication between the booster system and the CIU 110 is established by use of an RS-485 cable. Please note that a separate GENIbus module must be installed in the CU 351.

It is to be used with the products which do not support the CIM module directly, namely:

- Grundfos CU 351 Hydro MPC
- Grundfos CU 351 Control MPC.

Grundfos Hydro Multi-B with CIM 110 fitted

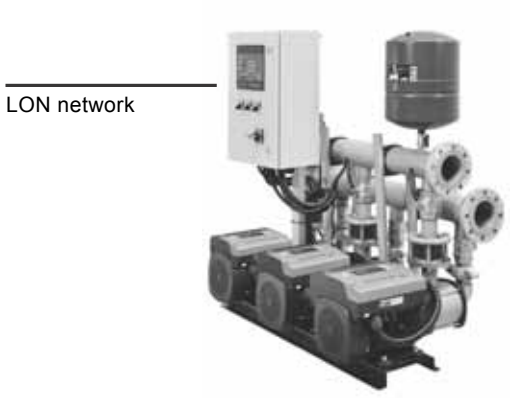

Fig. 1 CIM 110 solution for Hydro Multi-B and CU 352 MPC

Grundfos Hydro MPC connected to CIU 110

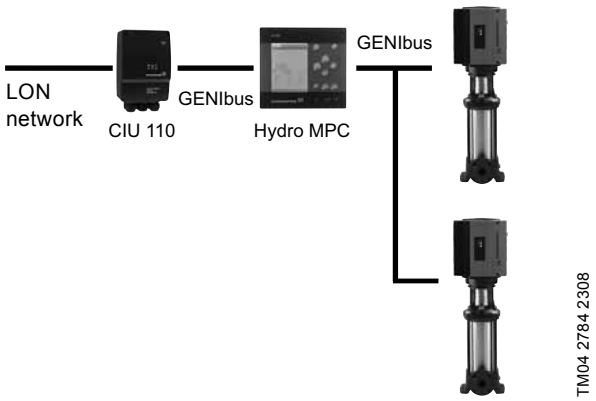

Fig. 2 Example of CIU 110 solution with CU 351

3. Installation

The LON module is programmed on delivery. This means that the application program will start when the power supply is switched on.

The customer has to install the network, including assignment of module addresses, and make the required bindings.

4. CIM 110 LON module

The LON module is designed using an FT 3150 neuron transceiver, an FT-X1 transformer and a 64 Kbyte flash memory which enables updating of software.

This functional profile is compliant with version 1.0 of "Pump Controller Object" from LonMark International.

The LON module has been certified to adhere to LonMark Application Layer interoperability guidelines 3.4.

Self-documentation strings are used. This means that an installation tool can access the relevant information via the network.

The XIF file can be found on the CD-ROM with this functional profile.

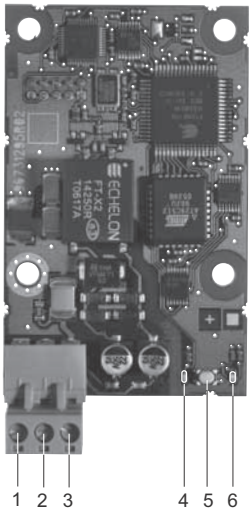

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Fig. 3 CIM 110 LON module

Pos.	Designation	Description
1	A	LON terminal A
2	B	LON terminal B
3	Screen	LON terminal for cable screen
4	LED1	Yellow service LED
5	Pin	Service pin (push-button)
6	LED2	Red/green status LED for internal communication between the CIM 110 and the controller.

On Multi-E, you only need a CIM 110 in the master pump.

If there is a CIM 110 module in both pumps, write the control commands to each pump.

A TPED model H is essentially a Multi-E model H with two pumps. Mount a CIM 110 module in the master head.
MAGNA3 Twinpump in multipump mode requires a CIM 110 module installed in the master pump.

4.1 Connecting the LON module

We recommend using a cable according to Echelon standards.

Examples of recommended cable types

- Belden 85102
- Belden 8471
- Level IV, 22 AWG
- JY(St) Y 2 x 2 x 0.8
- TIA Category 5.

A LON network must be terminated. The termination depends on the network topology chosen.

Fitting the cable

See fig. 4.

1. Connect the conductors to terminal A (pos. 1).
2. Connect the conductors to terminal B (pos. 2).
3. Connect the twisted screen ends to terminal "Screen" (pos. 3).

Note

The screen must only be connected to the screen terminal of the CIM 110 LON module. See fig. 4, pos. 3.
The cable screen must never be connected to earth via the earth clamp. See fig. 4, pos. 4.

Note

The stripped part of the cable screen must be as short as possible to reduce the impedance at high frequencies.

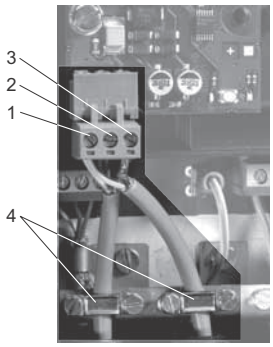

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Fig. 4 Connecting the LON module

Pos.	Description
1	LON terminal A
2	LON terminal B
3	LON terminal for cable screen
4	Earth clamp

4.2 Registration in a LON network

Controllers connected to a CIM/CIU 110 are registered by a LON network in one of these ways:

- Service pin
- Bar code label.

Service pin

When the service pin push-button of the module is activated, the module will send a unique 48 bit ID code (Neuron ID) which is registered in the LON network. See fig. 5.

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Fig. 5 Service pin

Bar code label

The Neuron ID on the module or on the enclosed bar code label is scanned and registered in the LON network. The bar code of the Neuron ID is in Code 128 format. The additional bar code label can be attached to the building installation plan.

4.3 LEDs

The CIM/CIU 110 has two LEDs. See fig. 3.

- Yellow service LED (LED1)
- Red/green status LED (LED2) for internal communication between the CIM/CIU 110 and the controller.

4.3.1 LED1

The yellow LED on the CIM/CIU 110 functions as a service LED. When the controller is connected to the power supply, the service LED will flash once and then remain off if the installation has been made correctly. In case of deviations, see section *17. Fault finding* and Echelon documentation.

The WINK command is supported by the CIM/CIU 110.

When the CIM/CIU 110 receives a WINK command, the service LED (LED1) will flash five times with 2-second intervals and a duty cycle of 50 %. After five flashes, the service LED (LED1) goes out. See fig. 6.

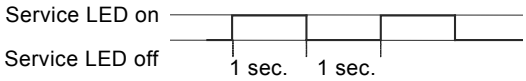

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Fig. 6 Flashing pattern

This flashing pattern must not be confused with the flashing pattern of an unconfigured device which will flash with 1-second intervals and a duty cycle of 50 %.

In a standard installation, the service LED (LED1) is permanently off.

The use of a WINK command does not affect the operation of the CIM/CIU 110 in any way.

4.3.2 LED2

Status	Description
Off.	The CIM/CIU 110 has been switched off.
Flashing red.	No internal communication between the CIM/CIU 110 and the controller.
Permanently red.	The CIM/CIU 110 does not support the connected controller.
Permanently green.	Internal communication between the CIM/CIU 110 unit, and the controller is OK.

5. Considerations when installing the controller

To allow the CIM/CIU 110 to operate the Hydro MPC controller, the controller must be set to operation via bus (control source menu: settings/secondary functions/control source/controlled via bus). The CIM/CIU 110 will read out values from the controller at any time, but the controller will not be controlled until the control source of the controller is set to "bus" via the operator display.

Some physical values have duplicate readouts, i.e. the process values for discharge pressure (nvoDisPress, nvoDisPressF), pump differential pressure (nvoPress, nvoPressF), external pressure (nvoExtPressure, nvoExtPressureF) and flow (nvoFlow, nvoFlowF).

These physical value pairs have a standard- and an extended-range variable.

All the NVOs are active at all times. If the physical value in the application is higher than the standard-range value, this will saturate to its invalid value.

Example

For an application with a maximum flow higher than 650 m^3/h, the nvoFlow will display the invalid value (655.35 m^3/h, 0xFFFF) for pump flows above this limit.

At the time of installation, it should be determined which of the NVO pair members to monitor.

Example

For an application with a maximum flow higher than 650 m^3/h, nvoFlowF should be used.

For an application with a maximum flow lower than 650 m^3/h, nvoFlow should be used as it offers a higher resolution.

See description of the NVOs in section *12. Details of the pump controller's functional blocks*.

For further details about the configuration, see the controller documentation.

6. Selection of primary sensor

The controller can operate with different sensors used as the primary sensor. The sensor feedback signal is used to control the application in closed loop.

It is not all sensor types that are recognised by the CIM/CIU 110. If the selected primary sensor is not recognised by the CIM/CIU 110, the CIM/CIU 110 will prevent the controller from operating (the controller will be in STOP).

The types of primary sensor recognised by the CIM 110 are listed in the table below.

Primary sensor	Related NVO on the CIM/CIU 110
Flow	nvoFlow nvoFlowF
Discharge pressure	nvoDisPress nvoDisPressF
External pressure, External differential pressure	nvoExtPress nvoExtPressF
Differential pressure, pump	nvoPressure nvoPressureF
Flow-pipe temperature	nvoFlowPipeTemp
Return-pipe temperature	nvoRtnPipeTemp
Differential temperature	nvoDiffTemp
Surrounding temperature	nvoSurroundTemp
UPE Series 2000, flow rate	nvoFlow nvoFlowF
UPE Series 2000, differential pressure	nvoPressure nvoPressureF

The CIM/CIU 110 relates to the primary sensor in the following way:

The primary sensor will be automatically detected by the CIM/CIU 110 without user intervention.

- nviPumpSetpoint (set in percent) will automatically be scaled to the range of the primary sensor.
  See section *12. Details of the pump controller's functional blocks*.
- nvoPumpCapacity (read out in percent) is the actual value of the primary sensor scaled into its range.
  See section *12. Details of the pump controller's functional blocks*.

7. Power-on behaviour

A Grundfos CIM 110 is designed to run with the following LON configuration:

- Node ID: 1
- Subnet ID: 1
- Domain ID: 00:00:00:00:00:00 (6 bytes).

The CIM 110 will immediately start operating with these settings on the LON network when the power supply is first switched on. These settings can be changed with an installation tool (not supplied by Grundfos).

If the CIM 110 is switched off and on (power cycle), the actual NV values in the CIM 110 will be lost and reset to their default values. The NV default values can be found in section *12. Details of the pump controller's functional blocks*.

CP values are preserved in the CIM 110 over power cycles.

When switched on, the CIM 110 starts reading output values from the controller (pressure, flow, etc.).

Note LON readouts are not valid until the controller has finished its startup sequence.

No other operation of the controller is applied until an update of any of the following NVs is received via the LON network:

- nviPumpSetpoint
- nviPumpOpMode.

When an update is received, the CIM 110 will start operating the controller.

The CIM 110 will poll the following NVs immediately after power-on (if they are bound):

- nviPumpSetpoint
- nviPumpOpMode.

The CIM 110 will continue to poll these NVs with 10-second intervals (if they are bound) until an update of any of the NVs is received via the LON network.

8. SNVT/UNVT details

Network variables of the node object are described in section *14. Details of the node object's functional block*.

8.1 Mandatory and optional network variables

NV #	Name	SNVT type	SNVT index	Description	CU 323	CU 35x	Multi-E
1	nviPumpSetpoint	SNVT_switch	95	Setpoint for normal operation	●	●	●*
2	nviPumpOpMode	SNVT_hvac_mode	108	Requested operating mode	●	●	●*
3	nvoPumpCapacity	SNVT_lev_percent	81	System capacity as percentage of maximum	●	●	●
4	nvoEffOpMode	SNVT_hvac_mode	108	Effective operating mode	●	●	●
5	nvoControlMode	SNVT_dev_c_mode	162	Effective device control mode	●	●	●
13	nvoPumpStatus	SNVT_dev_status	173	Status, diagnostic information	●	●	●
14	nvoPressure	SNVT_press	30	Pressure	●	●	●
15	nvoFlow	SNVT_flow_p	161	Flow	-	●	●
18	nvoRuntime	SNVT_time_hour	124	Operating hours	●	●	●
19	nvoPumpFault	SNVT_dev_fault	174	Fault status	●	●	●
23	nvoPowerKilo	SNVT_power_kilo	28	Electrical power consumption in kilowatt	●	●	●

* On Multi-E, you only need a CIM 110 in the master pump.

If there is a CIM 110 module in both pumps, write the control commands to each pump.

A TPED model H and MAGNA3 Twinpump is essentially a Multi-E model H with two pumps. Mount a CIM 110 module in the master pump.

Note NV # number is according to SFPTpumpController.

8.2 Manufacturer-defined network variables

Name	SNVT type	SNVT index	Description	CU 323	CU 35x	Multi-E
nvoFlowF	SNVT_flow_f	53	Flow (floating point)	-	●	●
nvoEnergyConsumL	SNVT_elec_kwh_l	146	Energy consumption	●	●	●
nvoPressureF	SNVT_press_f	59	Differential pressure across the pump flanges in Pascal (floating point)	●	●	●
nvoInletPressure	SNVT_press	30	Inlet pressure	●	●	●
nvoDisPress	SNVT_press	30	Discharge pressure	●	●	●
nvoDisPressF	SNVT_press_f	59	Discharge pressure (floating point)	●	●	●
nvoExtPressure	SNVT_press	30	External pressure	-	●	●
nvoExtPressureF	SNVT_press_f	59	External pressure (floating point)	-	●	●
nvoFlowPipeTemp	SNVT_temp_p	105	Flow-pipe liquid temperature	-	●	●
nvoRtnPipeTemp	SNVT_temp_p	105	Return-pipe liquid temperature	-	●	-
nvoDiffTemp	SNVT_temp_diff_p	147	Differential temperature	-	●	●
nvoSurroundTemp	SNVT_temp_p	105	Ambient temperature	-	●	●
nvoSystemStatus	SNVT_state	83	Bit fields reporting system status	●	●	●
nvoLevel	SNVT_length_f	54	Tank level	-	●	●
nvoAlarmCode	SNVT_cont	8	Current system alarm code	●	●	●
nvoWarningCode	SNVT_cont	8	Current system warning code	●	●	●
nviGrundfosCmd	UNVT_GF_cmd		Request for sw/hw version	●	●	●
nvoGrundfosInfo	SNVT_str_asc	36	Sw/hw version according to nviGrundfosCmd	●	●	●

8.3 Optional subpump (UFPT) network variables

Name	SNVT type	SNVT index	Description	CU 323	CU 35x	Multi-E
nvoSPumpSpeed	SNVT_lev_percent	81	Pump speed in percentage of full speed	●	●	●
nvoSPumpRuntime	SNVT_time_hour	124	Pump operating hours	●	●	●
nvoSPumpFault	SNVT_dev_fault	174	Pump fault status	●	●	●
nvoSPumpStatus	SNVT_dev_status	173	Pump status	●	●	●

9. SCPT/UCPT details

9.1 Configuration properties

SCPT name NV name Type or SNVT	SCPT index	Associated NVs	Description	CU 323	CU 35x	Multi-E
SCPTmaxSendTime nciSndHrtBt SNVT_time_sec (107)	49	nv3, nv4, nv5, nv13	Maximum period of time that will elapse before the functional block automatically updates the associated network variables.	•	•	•
SCPTpumpCharacteristic nroPumpChar (structure)	233	Entire functional block	Maximum flow, maximum pressure and maximum speed of the pump define the pump characteristics.	•	•	•
SCPTlocation nciLocation SNVT_str_asc (36)	17	Entire functional block	Used to provide physical location of the device.	•	•	•
SCPTdeviceControlMode nciControlMode SNVT_dec_c_mode (162)	238	Entire functional block	Control mode for normal operation. **Note:** The CU 323 can only run in constant-pressure mode when controlled from a CIM 110.	-	•	•

10. Application examples

The CIM/CIU 110 can be used for the control and monitoring of a booster system or for monitoring only.

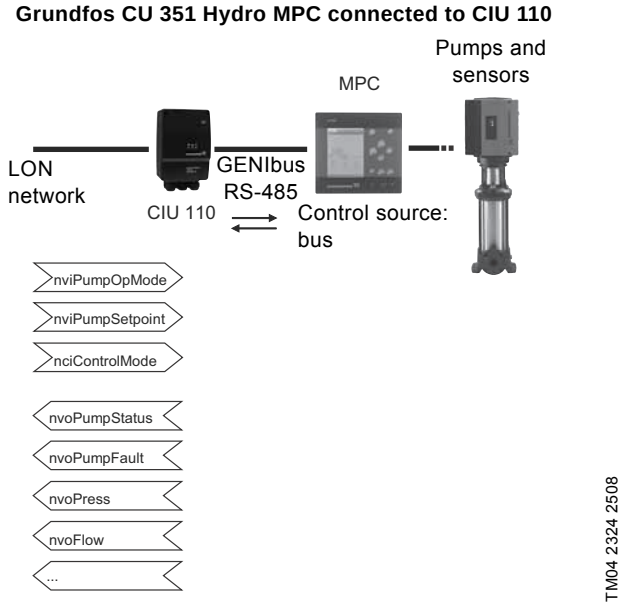

Fig. 7 CIU 110 for control and monitoring of CU 351

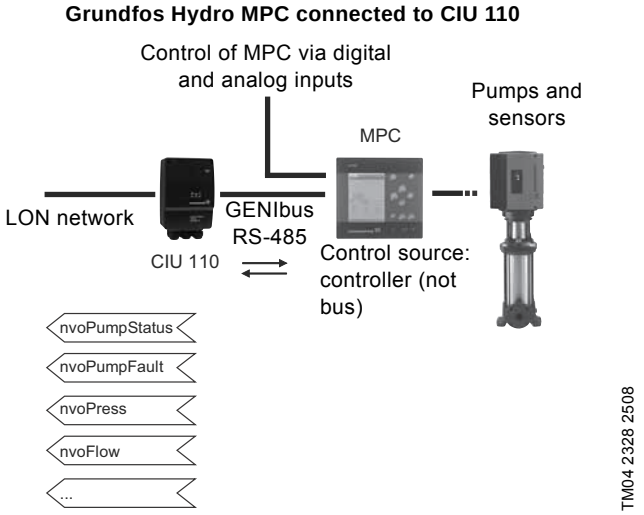

Fig. 8 CIU 110 for monitoring only

11. Override functionality

The pump controller profile can override the setpoint. If nviPumpOpMode is set to any of the values in fig. 9, the nviPumpSetpoint will be overridden.

The controller will not return to normal setpoint control until the nviPumpOpMode is set to HVAC_AUTO. The override priority can be seen in fig. 9.

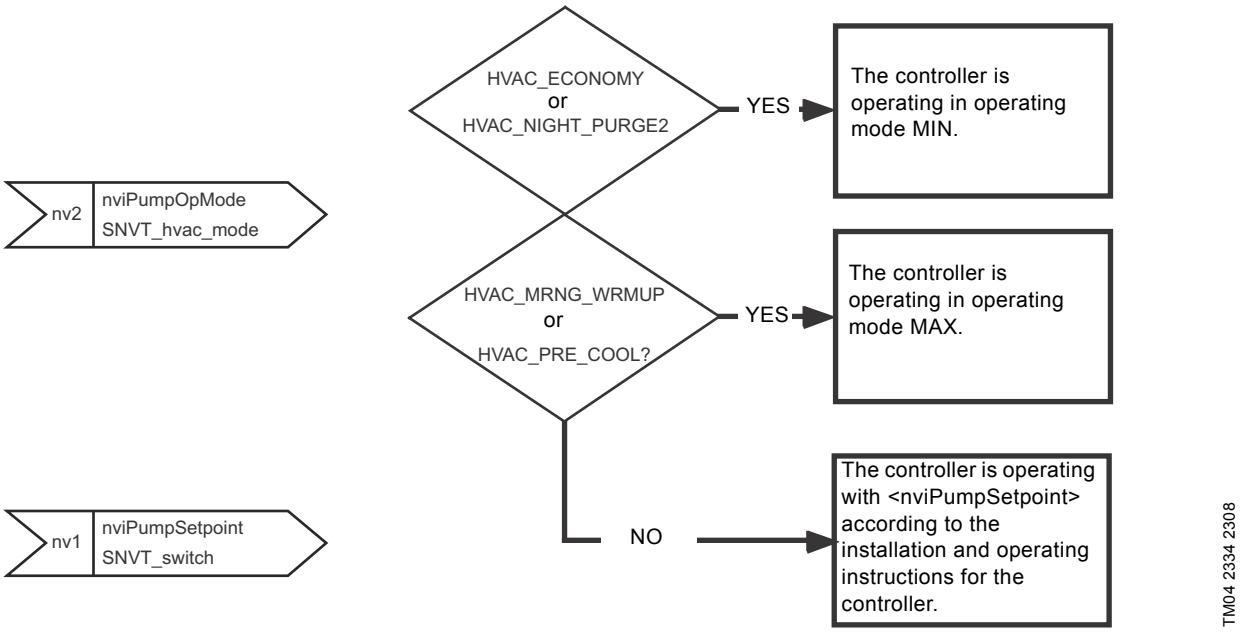

Fig. 9 Override functionality

12. Details of the pump controller's functional blocks

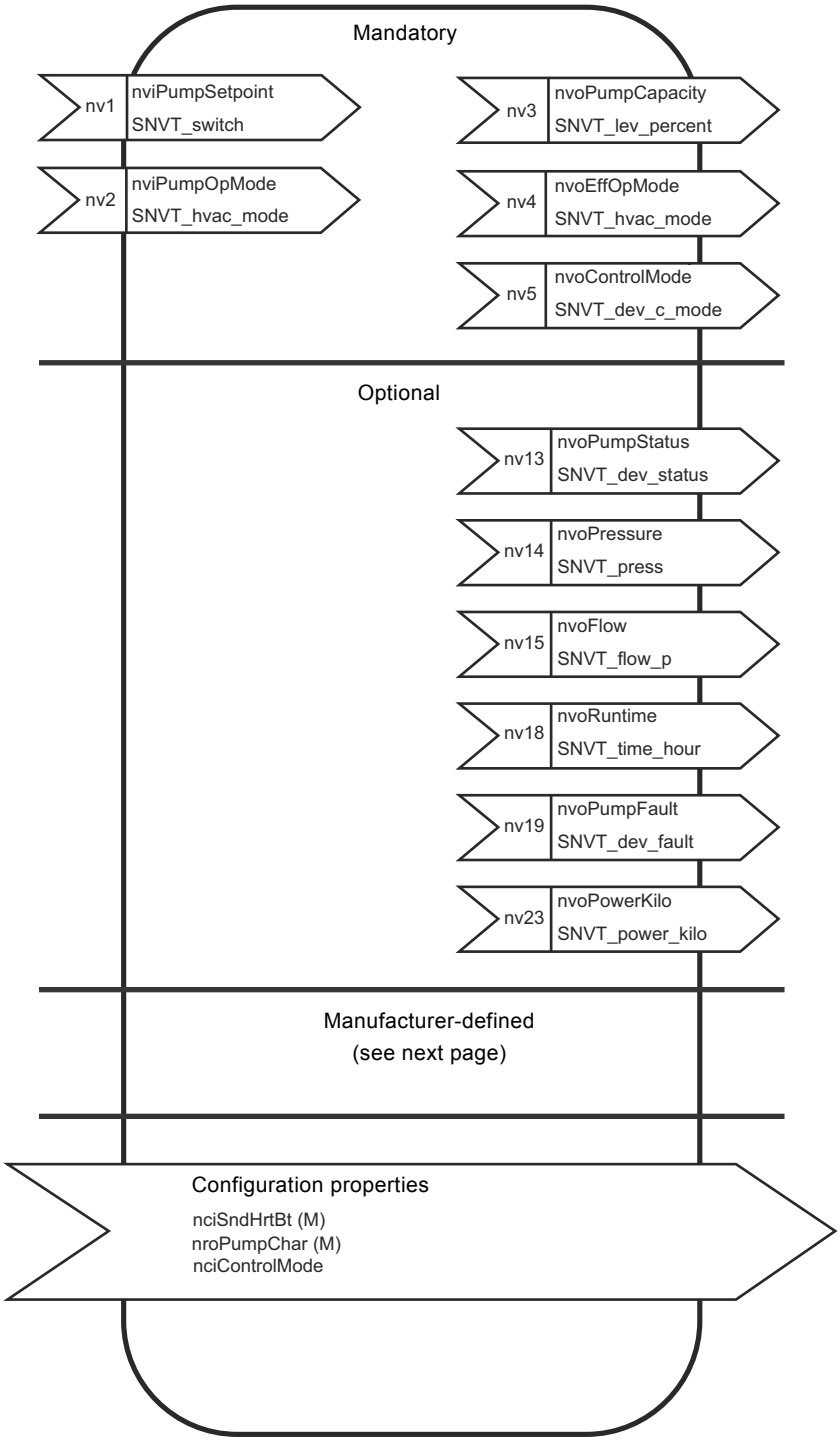

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Fig. 10 Pump controller (standard part)

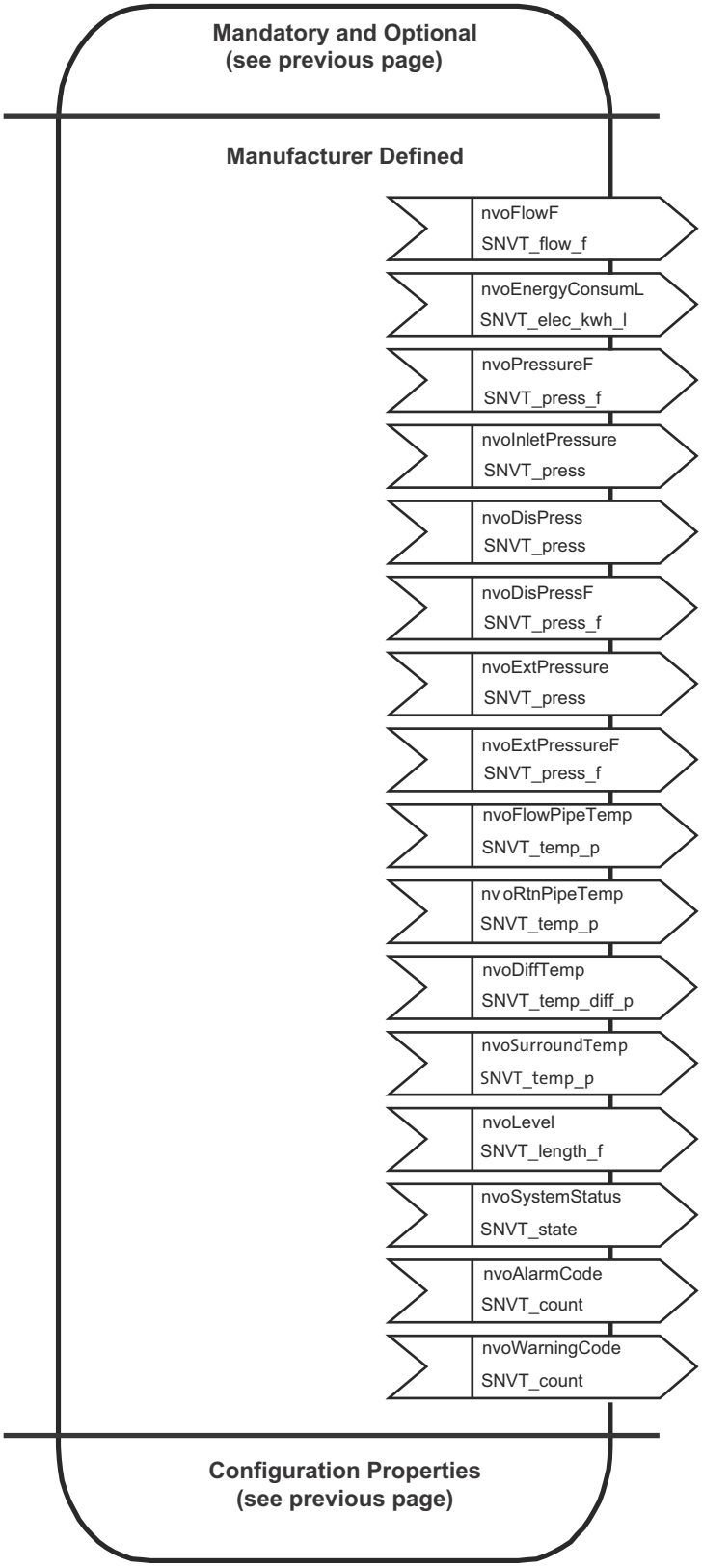

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Fig. 11 Pump controller (manufacturer-defined part)

12.1 Pump setpoint

`network input SNVT_switch nviPumpSetpoint;`

This network variable input provides start/stop control and a setpoint. The setpoint is given as a percentage of the maximum sensor value. The setpoint value can represent any of the sensors mentioned in section *6. Selection of primary sensor*. The effective operating mode of the pump (nvoControlMode) will indicate the type of control, if applicable, but not the actual sensor used. See section *12.5 Effective device control mode*.

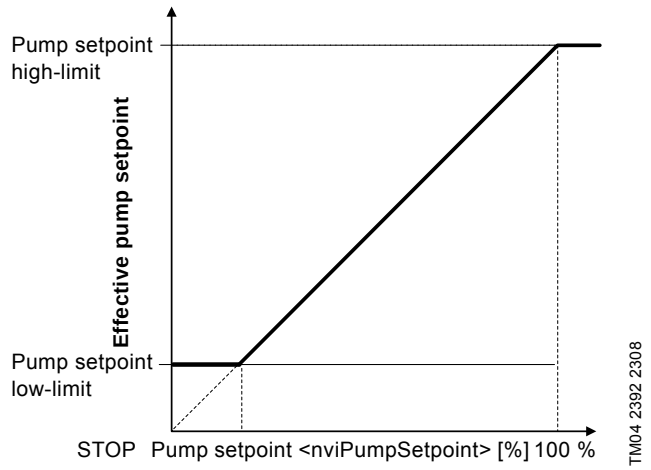


Fig. 12 Effective setpoint for closed-loop operation

The graph in fig. 12 applies to sensors with sensor ranges larger than or equal to 0.

When a sensor with a negative range is used, see section *16. Sensor ranges* for calculation of the effective setpoint.

$$X = \frac{\text{Setpoint low-limit}}{\text{Setpoint high-limit}} \times 100\ \%$$

Example

If the control mode is constant pressure (nvoControlMode = DCM_PRESS_CONST), and the setpoint limits for this control mode are 10 kPa and 100 kPa, "X" can be calculated to 10 %. This means that a setpoint value of 1 to 10 % provides a setpoint of 10 kPa (0 % stops the pump).

A setpoint value of 11 to 100 % provides a setpoint of 11 to 100 kPa.

Valid range

State	Value	Equivalent percent	Requested speed
0	n/a	n/a	STOP
1	0	0 %	STOP
1	1 to 200	0.5 to 100.0 %	0.5 to 100.0 %
1	201 to 255	100.0 %	100.0 %

The CIM 110 will poll this network variable after power-up (if bound) to ensure a correct startup value. It will keep polling the bound remote device with 10-second intervals until a valid value is received.

After power-up, a controller will operate with its last logged remote setpoint (and operating mode) until a valid input is given to any of the following network variables: nviPumpSetpoint or nviPumpOpMode.

Default value

The default value is 0 %, and the controller is stopped.

12.2 Requested pump operating mode

`network input SNVT_hvac_mode nviPumpOpMode;`

This network variable input is typically used by a supervisory controller to override the pump controller operating mode. If the requested mode is not supported by the unit, the unit will treat it as an invalid value (treated as HVAC_NUL).

When the mode is HVAC_AUTO, the nviPumpSetpoint defines the setpoint of the controller.

When the mode is HVAC_MRNG_WRMUP or HVAC_PRE_COOL, the Hydro MPC operates at maximum capacity.

To save energy during the night, in the summer or under low-load conditions, the mode HVAC_ECONOMY or HVAC_NIGHT_PURGE can be used. In this mode, the controller operates at minimum capacity.

Valid range

Value	Identifier	Description
0	HVAC_AUTO	Normal operation: nviPumpSetpoint defines the effective setpoint.
2	HVAC_MRNG_WRMUP	Morning warm-up: maximum-capacity mode.
4	HVAC_NIGHT_PURGE	Night purge: minimum-capacity mode.
5	HVAC_PRE_COOL	Morning cool-down: maximum-capacity mode.
6	HVAC_OFF for Twin pump MGE model H/I	The pump has been set to local mode via the network. In this mode, it can't be controlled via the network. It will continue to monitor the outputs.
13	HVAC_ECONOMY	Energy saving: minimum-capacity mode.
-1 (0xFF)	HVAC_NUL	Invalid value.

The CIM 110 will poll this network variable after power-up (if bound) to ensure a correct startup value. It will keep polling the bound remote device with 10-second intervals until a valid value is received.

After power-up, the controller will operate with its last logged remote operating mode (and setpoint) until a valid input is given to any of the following network variables: nviPumpSetpoint or nviPumpOpMode.

Default value

The default value for nviPumpOpMode is HVAC_AUTO.

12.3 Pump capacity

`network output SNVT_lev_percent nvoPumpCapacity;`

This network variable output provides the actual pump capacity as a percentage of the maximum sensor range value when operating with a positive sensor range.

When the minimum sensor range value is lower than 0, the actual pump capacity is calculated as a percentage of the sensor range.

Valid range

-163.840 to 163.830 % (0.005 % or 50 ppm).

The value of 0x7FFF (163.835 %) represents invalid data and indicates that the capacity cannot be estimated.

Only values ranging from 0 to 100 % or invalid values are used.

When transmitted

This value is transmitted immediately when it has changed more than 0.5 % for nvoControlMode = DCM_SPEED_CONST or more than 2 % for other values of nvoControlMode.

Additionally, this network variable will be transmitted as a heartbeat output on a regular basis as specified by the maximum send time nciSndHrtBt configuration property.

12.4 Effective operating mode

network output SNVT_hvac_mode nvoEffOpMode;

This network variable output provides the actual operating mode.

When the controller is controlled by the CIM/CIU 110, the value of this network variable is the same as the value of the requested operating mode (nviPumpOpMode).

When the controller is not controlled by the CIM/CIU 110, this network variable displays the current operating mode.

Valid range

Value	Identifier	Description
0	HVAC_AUTO	Normal operation: nviPumpSetpoint defines the effective setpoint.
2	HVAC_MRNG_WRMUP	Morning warm-up: maximum-capacity mode.
4	HVAC_NIGHT_PURGE	Night purge: minimum-capacity mode.
5	HVAC_PRE_COOL	Morning cool-down: maximum-capacity mode.
6	HVAC_OFF for Twin pump MGE model H/I	The pump has been set to local mode via the network. In this mode, it can't be controlled via the network. It will continue to monitor the outputs.
13	HVAC_ECONOMY	Energy saving: minimum-capacity mode.
-1 (0xFF)	HVAC_NUL	Invalid value.

When transmitted

This value is transmitted immediately when it has changed.

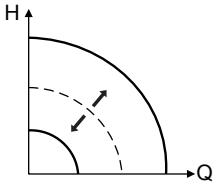
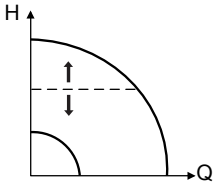
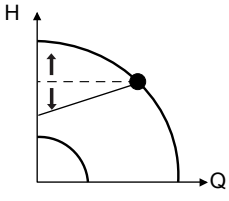
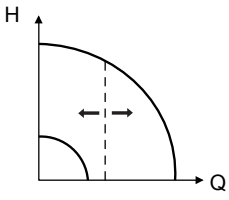
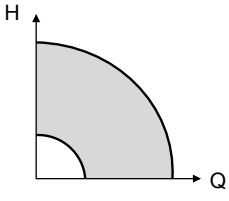
Additionally, this network variable will be transmitted as a heartbeat output on a regular basis as specified by the maximum send time nciSndHrtBt configuration property.

12.5 Effective device control mode

`network output SNVT_dev_c_mode nvoControlMode;`

This network variable output provides the actual control mode of the controller. The actual control mode is determined by nciControlMode and the type of sensor used by the controller.

Valid range

Control mode	Description	
DCM_SPEED_CONST (0) The controller is operating in open-loop mode.	The controller setpoint will be interpreted as percentage of the maximum open-loop performance of the controller.	
DCM_PRESS_CONST (1) The controller is operating in constant-pressure mode.	The controller setpoint will be interpreted as pressure setpoint. The controller will maintain a constant pressure.	
DCM_PRESS_COMP (2) The controller is operating in compensated-pressure mode.	The controller setpoint will be interpreted as basic setpoint for the compensated-pressure mode (the black dot in the drawing). The CU 351 will maintain a constant pressure, but automatically lower the actual pressure setpoint dependent on the flow.	
DCM_FLOW_CONST (3) The controller is operating in constant-flow mode.	The controller setpoint will be interpreted as flow setpoint. The controller will maintain a constant flow. The controlled flow is determined by the controller.	
DCM_TEMP_CONST (5) The controller is operating in constant-temperature mode.	The controller setpoint will be interpreted as temperature setpoint. The controller will maintain a constant temperature. The controlled temperature is determined by the controller.	

For level sensors, nvoControlMode will display DCM_PRESS_CONST.

Note The Hydro Multi-B will always run in DCM_PRESS_CONST mode. It is not possible to run tank-filling mode with LON.

When transmitted

This value is transmitted immediately when it has changed.

Additionally, this network variable will be transmitted as a heartbeat output on a regular basis as specified by the maximum send time nciSndHrtBt configuration property.

12.6 Pump status, diagnostic information

`network output SNVT_dev_status nvoPumpStatus;`

This network variable output provides detailed diagnostic information on the status of the pump controller.

Pump status, diagnostic information

Bit name	Description
device_fault	A pump- or controller-related fault or warning has been detected. See section *12.23 Pump fault status* for detailed information.
supply_fault	A system-related fault or warning has been detected. See section *12.23 Pump fault status* for detailed information.
local_control	The controller is not controlled via the LON network. It has been set to local mode by hardware override from the controller.
running	The controller is running (does not necessarily mean that any pump is running).

When transmitted

This value is transmitted immediately when it has changed.

Additionally, this network variable will be transmitted as a heartbeat output on a regular basis as specified by the maximum send time nciSndHrtBt configuration property.

12.7 Pump differential pressure (standard range)

`network output SNVT_press nvoPressure;`

This network variable output provides the differential pressure across the system flanges as measured by the controller using a differential-pressure sensor or as an estimated pump differential pressure collected from Series 2000 pumps connected to the controller (TPE Series 2000).

If the maximum pump differential pressure is higher than 3200 kPa, nvoPressureF should be used as it offers an extended range.

Section *5. Considerations when installing the controller* provides more information on the coherence of nvoPressure and nvoPressureF.

Valid range

-3,276.8 to 3,275.0 kPa (0.1 kPa).

The value of 0x7FFF (3,276.7 kPa) represents invalid data and indicates that the pressure cannot be measured or estimated, that no differential-pressure sensor is connected or that the differential pressure is higher than 3200 kPa.

When transmitted

This value is transmitted immediately when it has changed more than 2 kPa.

12.8 Pump differential pressure (extended range)

`network output SNVT_press_f nvoPressureF;`

This network variable output provides the differential pressure across the system flanges as measured by the controller using a differential-pressure sensor or as an estimated pump differential pressure collected from Series 2000 pumps connected to the controller (TPE Series 2000).

If the maximum pump differential pressure is lower than 3200 kPa, nvoPressure should be used as it offers a higher resolution.

Section *5. Considerations when installing the controller* provides more information on the coherence of nvoPressure and nvoPressureF.

Valid range

-3.40282E38 to 3.40282E38 Pa.

If no pump differential-pressure sensor is available in the system, nvoPressureF will display a value of NaN (Not a Number).

When transmitted

This value is transmitted immediately when it has changed more than 2 kPa.

12.9 Pump inlet pressure

`network output SNVT_press nvoInletPressure;`

This network variable output provides the system inlet pressure as measured by the controller.

If no inlet pressure sensor is available in the system, nvoInletPressure will display the invalid value.

Valid range

-3,276.8 to 3,276.6 kPa (0.1 kPa).

The value of 0x7FFF (3,276.7 kPa) represents invalid data and indicates that the pressure cannot be measured or that no inlet pressure sensor is connected.

When transmitted

This value is transmitted immediately when it has changed more than 2 kPa.

12.10 Pump discharge pressure (standard range)

`network output SNVT_press nvoDisPress;`

This network variable output provides the system discharge pressure as measured by the controller.

If the maximum pump discharge pressure is higher than 3200 kPa, nvoDisPressF should be used as it offers an extended range.

Section *5. Considerations when installing the controller* provides more information on the coherence of nvoDisPress and nvoDisPressF.

Valid range

-3,276.8 to 3,275.0 kPa (0.1 kPa).

The value of 0x7FFF (3,276.7 kPa) represents invalid data and indicates that the pressure cannot be measured, that no discharge-pressure sensor is connected or that the discharge pressure is higher than 3200 kPa.

When transmitted

This value is transmitted immediately when it has changed more than 2 kPa.

12.11 Pump discharge pressure (extended range)

`network output SNVT_press_f nvoDisPressF;`

This network variable output provides the discharge pressure across the pump flanges as measured by the controller.

If the maximum pump discharge pressure is lower than 3200 kPa, nvoDisPressF should be used as it offers a higher resolution.

Section *5. Considerations when installing the controller* provides more information on the coherence of nvoDisPress and nvoDisPressF.

Valid range

-3.40282E38 to 3.40282E38 Pa.

If no discharge-pressure sensor is available in the system, nvoDisPressF will display a value of NaN (Not a Number).

When transmitted

This value is transmitted immediately when it has changed more than 2 kPa.

12.12 Pump external pressure (standard range)

`network output SNVT_press nvoExtPressure;`

This network variable output provides the system external pressure as measured by the controller.

If the maximum pump external pressure is higher than 3200 kPa, nvoExtPressureF should be used as it offers an extended range.

Section *5. Considerations when installing the controller* provides more information on the coherence of nvoExtPressure and nvoExtPressureF.

Valid range

-3,276.8 to 3,275.0 kPa (0.1 kPa).

The value of 0x7FFF (3,276.7 kPa) represents invalid data and indicates that the pressure cannot be measured, that no external-pressure sensor is connected or that the external pressure is higher than 3200 kPa.

When transmitted

This value is transmitted immediately when it has changed more than 2 kPa.

12.13 Pump external pressure (extended range)

network output SNVT_press_f nvoExtPressureF;

This network variable output provides the external system pressure as measured by the controller.

If the maximum pump external pressure is lower than 3200 kPa, nvoExtPressure should be used as it offers a higher resolution.

Section *5. Considerations when installing the controller* provides more information on the coherence of nvoExtPressure and nvoExtPressureF.

Valid range

-3.40282E38 to 3.40282E38 Pa.

If no external-pressure sensor is available in the system, nvoPressureF will display a value of NaN (Not a Number).

When transmitted

This value is transmitted immediately when it has changed more than 2 kPa.

12.14 Pump flow (standard range)

`network output SNVT_flow_p nvoFlow;`

This network variable output provides the flow through the pump as measured by the controller or as an estimated flow collected from TPE Series 2000 pumps connected to the controller.

If the maximum pump flow is higher than 650 m^3/h, nvoFlowF should be used as it offers an extended range.

Section *5. Considerations when installing the controller* provides more information on the coherence of nvoFlow and nvoFlowF.

Valid range

0 to 655.34 m^3/h (0.01 m^3/h).

The value of 0xFFFF (655.35 m^3/h) represents invalid data and indicates that the flow cannot be estimated, that no flow sensor is connected or that the measured flow is higher than 655.34 m^3/h.

When transmitted

This value is transmitted immediately when it has changed more than 0.1 m^3/h.

12.15 Pump flow (extended range)

`network output SNVT_flow_f nvoFlowF;`

This network variable output provides the flow through the pump system as measured by the controller or as an estimated flow collected from TPE Series 2000 pumps connected to the controller.

If the maximum pump flow is lower than 650 m^3/h, nvoFlow should be used as it offers a higher resolution.

Section *5. Considerations when installing the controller* provides more information on the coherence of nvoFlow and nvoFlowF.

Valid range

-3.40282E38 to 3.40282E38 l/s.

When transmitted

This value is transmitted immediately when it has changed more than 1 l/s.

12.16 Flow-pipe liquid temperature

`network output SNVT_temp_p nvoFlowPipeTemp;`

This network variable output provides the flow-pipe liquid temperature in the hydraulic system as measured by the controller.

Valid range

-273.17 to +327.66 °C (0.01 °C).

The value of 0x7FFF (327.67 °C) represents invalid data and indicates that the temperature cannot be measured or that no flow-pipe temperature sensor is connected.

When transmitted

This value is transmitted immediately when it has changed more than 0.1 °C.

12.17 Return-pipe liquid temperature

`network output SNVT_temp_p nvoRtnPipeTemp;`

This network variable output provides the return-pipe liquid temperature in the hydraulic system as measured by the controller.

Valid range

-273.17 to +327.66 °C (0.01 °C).

The value of 0x7FFF (327.67 °C) represents invalid data and indicates that the temperature cannot be measured or that no return-pipe temperature sensor is connected.

When transmitted

This value is transmitted immediately when it has changed more than 0.1 °C.

12.18 Differential liquid temperature

`network output SNVT_temp_p nvoDiffTemp;`

This network variable output provides the differential liquid temperature of the hydraulic system as measured by the controller.

Valid range

-273.17 to +327.66 °C (0.01 °C).

The value of 0x7FFF (327.67 °C) represents invalid data and indicates that the temperature cannot be measured or that no differential-temperature sensor is connected.

When transmitted

This value is transmitted immediately when it has changed more than 0.1 °C.

12.19 Surrounding temperature

`network output SNVT_temp_p nvoSurroundTemp;`

This network variable output provides the surrounding temperature of the hydraulic system as measured by the controller.

Valid range

-273.17 to +327.66 °C (0.01 °C).

The value of 0x7FFF (327.67 °C) represents invalid data and indicates that the temperature cannot be measured or that no surrounding-temperature sensor is connected.

When transmitted

This value is transmitted immediately when it has changed more than 0.1 °C.

12.20 Tank level

`network output SNVT_length_f nvoLevelF;`

This network variable output provides the liquid level in the tank of the hydraulic system as measured by the controller.

Valid range

0 to 3.40282E38 m.

A value of 3.40282E38 m represents invalid data and indicates that the level cannot be measured or that no level sensor is connected.

When transmitted

This value is transmitted immediately when it has changed more than 0.01 m.

12.21 Runtime

`network output SNVT_time_hour nvoRuntime;`

This network variable output provides the total number of operating hours of the controller.

After 65,535 hours, the counter is reset and will restart from zero (0).

Valid range

0 to 65,535 hours (1 hour), (2,730 days or 7.67 years).

When the total number of operating hours of the controller exceeds this value, nvoRuntime rolls over and starts from 0.

When transmitted

This value is transmitted immediately when it has changed.

12.22 System status

`network output SNVT_state nvoSystemstatus;`

This network variable output provides status information about the system.

Valid range

The bits in the table below are supported.

System status, diagnostic information

Bit name	Description
Bit 0	Proportional pressure is enabled.
Bit 1	Negative sensor range is enabled, and effective setpoint calculation is done as described in section *16.2 Negative sensor ranges*.
Bit 2	Zone pump 1 is installed.
Bit 3	Zone pump 2 is installed.
Bit 4	Zone pump 3 is installed.
Bit 5	Zone pump 4 is installed.
Bit 6	Zone pump 5 is installed.
Bit 7	Zone pump 6 is installed.

When transmitted

This value is transmitted immediately when it has changed.

12.23 Pump fault status

`network output SNVT_dev_fault nvoPumpFault;`

This network variable output provides fault information about the pump, based on warnings and alarms from the pump.

Both warnings and alarms will appear as faults in nvoPumpFault, except for warning and alarm codes corresponding to df_elect_failure and df_elect_failure_nf. For these, warnings will appear as df_elect_failure_nf, and alarms will appear as df_elect_failure.

Specific warning codes and alarm codes from the controller are displayed in nvoWarningCode and nvoAlarmCode.

Valid range

The valid range of SNVT_dev_fault.

If the CIM/CIU 110 is unable to communicate with the controller for 1 second, the df_elect_failure bit is set, and the alarm code 159 is initiated. The fault is visible on the node object as well. See section *14. Details of the node object's functional block*. This fault will not be visible in the controller.

The connection of a unsupporteed product initiates alarm code 159.

Alarm code 159 is generated from the CIM/CIU 110 solely and overrides any other alarm code present in the connected product.

Faults and warnings for the Hydro Multi-B and Hydro MPC

Bit name	Description	Corresponding warning/alarm
sf_voltage_low	Supply voltage is too low.	Undervoltage (40) Undervoltage transient (41) Cut-in fault (dV/dt) (42) Inrush fault (155)
sf_voltage_high	Supply voltage is too high.	Overvoltage (32)
sf_phase	Power missing phase.	Missing phase (2) Electronic DC-link protection activated (ERP) (14)
sf_no_fluid	No liquid in pump.	Dry running (57) Water shortage, level 1 (206) Cavitation (208) Water shortage, level 2 (214)
sf_press_low	System pressure is too low.	Underpressure (211)
sf_press_high	System pressure is too high.	Turbine operation (29) Overpressure (210)
df_motor_temp	Motor temperature is too high.	Overtemperature (64) Motor temperature 1 (65) Temperature too high, internal frequency converter module (t_m) (67)
df_motor_failure	Motor has fatal failure.	External fault signal (3) Too many restarts (from standby mode per 24 hours) (4) Too many hardware shutdowns (short standbys per minute) (7) Overload (48) Overcurrent (i_line, i_dc, i_mo) (49) Motor protection function, general shutdown (mpf) (50) Motor protection function, 3 sec. limit (54) Motor current protection activated (MCP) (55) Underload (56)
df_pump_blocked	Pump is blocked.	Blocked motor/pump (51)
df_elect_temp	Electronic temperature is too high.	-
df_elect_failure_nf	Electronic non-fatal failure.	**Note:** Warning codes only! Leakage current (1) Communication fault, pump (10) Performance requirement cannot be met (17) Setup conflict (25) External temperature/water temperature (t_w) (68) Hardware fault, type 1 (72) Hardware shutdown (HSD) (73) Internal communication fault (76) Communication fault, twin-head pump (77) Hardware fault, type 2 (80) Verification error, FE parameter area (EEPROM) (83) Verification error, BE parameter area (EEPROM) (85) Electronic rectifier protection activated (ERP) (105) Electronic inverter protection activated (EIP) (106) Communication fault, internal frequency converter module (156) Real-time clock out of order (157) Sensor limit 1 exceeded (190) Sensor limit 2 exceeded (191) Sensor limit 3 exceeded (192) Sensor limit 4 exceeded (193) Sensor limit 5 exceeded (194) Sensor limit 6 exceeded (195) Alarm on all pumps (203) Water leakage (207) Non-return valve fault (209) Diaphragm tank precharge pressure out of range (212) VFD not ready (213) Ethernet: No IP address from DHCP server (231) Ethernet: Auto-disabled due to misuse (232) Ethernet: IP address conflict (233)

Bit name	Description	Corresponding warning/alarm
df_elect_failure	Electronic fatal failure.	**Note:** Alarm codes only! Leakage current (1) Communication fault, pump (10) Performance requirement cannot be met (17) Setup conflict (25) External temperature/water temperature (t_w) (68) Hardware fault, type 1 (72) Hardware shutdown (HSD) (73) Internal communication fault (76) Communication fault, twin-head pump (77) Hardware fault, type 2 (80) Verification error, FE parameter area (EEPROM) (83) Verification error, BE parameter area (EEPROM) (85) Electronic rectifier protection activated (ERP) (105) Electronic inverter protection activated (EIP) (106) Communication fault, internal frequency converter module (156) Real-time clock out of order (157) Sensor limit 1 exceeded (190) Sensor limit 2 exceeded (191) Sensor limit 3 exceeded (192) Sensor limit 4 exceeded (193) Sensor limit 5 exceeded (194) Sensor limit 6 exceeded (195) Alarm on all pumps (203) Water leakage (207) Non-return valve fault (209) Diaphragm tank precharge pressure out of range (212) VFD not ready (213) Ethernet: No IP address from DHCP server (231) Ethernet: Auto-disabled due to misuse (232) Ethernet: IP address conflict (233)
df_sensor_failure	Sensor failure.	Sensor fault (as G10) (88) Signal fault, (feedback) sensor 1 (89) Setpoint signal outside range (96) Inconsistency between sensors (204) Level float switch sequence inconsistency (205)

When transmitted

This value is transmitted immediately when one of the bits has changed.

12.24 Alarm code

`network output SNVT_count nvoAlarmCode;`

This network variable output provides the currently active alarm code from the controller.

In case of a common communication interface module fault (code 159), which is generated in the CIM 110 solely, this will be displayed in nvoAlarmCode and override any alarm pending in the connected product.

Valid range

See the Grundfos alarm and warning section.

When transmitted

This value is transmitted immediately when it has changed.

12.25 Warning code

`network output SNVT_count nvoWarningCode;`

This network variable output provides the currently active warning code from the controller.

Valid range

See the Grundfos alarm and warning section.

When transmitted

This value is transmitted immediately when it has changed.

12.26 Power consumption in kilowatts

`network output SNVT_power_kilo nvoPowerKilo;`

This network variable output provides the actual power being consumed by the controller.

Valid range

0 to 6,553.4 kW (0.1 kW).

The value of 0xFFFF (6,553.5 kW) represents invalid data and indicates that the power consumption cannot be measured/estimated.

When transmitted

This value is transmitted immediately when it has changed more than 0.2 kW.

12.27 Energy consumption

`network output SNVT_elec_kwh_l nvoEnergyConsumL;`

This optional network variable output provides the accumulated electrical energy consumption of the pump.

After 214,748,364.6 kWh, the counter is reset and will restart from 0 kWh.

Valid range

-214,748,364.8 to 214,748,364.6 kWh (0.1 kWh).

The value of 0x7FFFFFFF (214,748,364.7 kWh) represents invalid data and indicates that the electrical energy consumption cannot be measured/estimated.

When transmitted

This value is transmitted immediately when it has changed.

12.28 Send heartbeat

`network input config SNVT_time_sec nciSndHrtBt;`

This network configuration property input sets the maximum period of time that will elapse before the functional block automatically updates the following network variables:

- nv3, nvoPumpCapacity
- nv4, nvoEffOpMode
- nv5, nvoControlMode
- nv13, nvoPumpStatus.

Valid range

0.0 to 6,553.4 sec. (0.1 sec.).

A value of 0xFFFF (6,553.5 sec.) is invalid and will disable the automatic update function.

A value of zero (0) will be used for the internal timer if the configured value is invalid. The value of zero (0) disables the "send heartbeat" function.

Default value

The default value is 0.0 (no automatic update).

12.29 Control mode for normal operation

`network input config SNVT_dev_c_mode nciControlMode;`

This network configuration property input defines the device control mode to be used for the normal operating mode. For more details about the control modes, see section *12.5 Effective device control mode*.

The nciControlMode is mainly used to choose between open-loop and closed-loop control. A value of nciControlMode of DCM_SPEED_CONST will bring the Hydro MPC into open-loop control. All other values of nciControlMode will bring the Hydro MPC into closed-loop control. A value of DCM_PRESS_COMP also enables flow compensation for the pressure control (proportional pressure).

nvoControlMode will reflect the actual sensor used for the closed-loop control.

Valid range

The valid range is the same as that of nvoControlMode.

nciControlMode	Control mode	Description
DCM_SPEED_CONST	Open loop	-
DCM_PRESS_COMP	Closed loop	If a pressure sensor is used, flow compensation is enabled.
DCM_PRESS_CONST DCM_FLOW_CONST DCM_PRESS_AUTO DCM_TEMP_CONST	Closed loop	-

Default value

The default control mode for a pump is DCM_PRESS_CONST (value = 1).

13. Details of the subpump's functional block

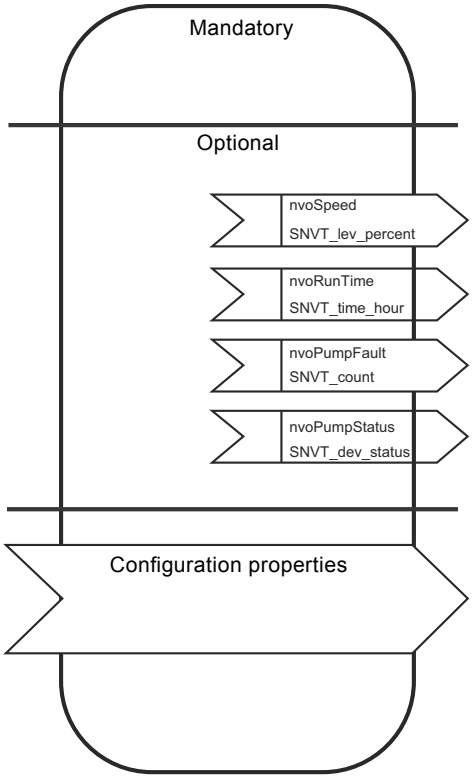


Fig. 13 Subpump (UFPT)

13.1 Pump speed

`network output SNVT_level_percent nvoSPumpSpeed;`

This network variable output provides the current speed of the pump as a percentage of its maximum speed.

Example:

nvoSPumpSpeed_1

nvoSPumpSpeed_2

nvoSPumpSpeed_3.

Valid range

-163.840 to 163.830 % (0.005 % or 50 ppm).

The value of 0x7FFF (163.835 %) represents invalid data and indicates that the pump speed cannot be measured/estimated.

When transmitted

This value is transmitted immediately when it has changed more than 0.5 %.

13.2 Pump runtime

`network output SNVT_time_hour nvoSPumpRuntime;`

This network variable output provides the total number of operating hours of the pump.

After 65,535 hours, the counter is reset and will restart from zero (0).

Example:

nvoSPumpRuntime_1

nvoSPumpRuntime_2

nvoSPumpRuntime_3.

Valid range

0 to 65,535 hours (1 hour), (2,730 days or 7.47 years).

When transmitted

This value is transmitted immediately when it has changed.

13.3 Pump fault status

`network output SNVT_dev_fault nvoSPumpFault;`

This network variable output provides fault information about the pump, based on warnings and alarms from the pump.

Both warnings and alarms will appear as faults in nvoPumpFault, except for warning and alarm codes corresponding to df_elect_failure and df_elect_failure_nf. For these, warnings will appear as df_elect_failure_nf, and alarms will appear as df_elect_failure.

See section *Pump faults, TPE Series 1000/2000, CME, CRE and UPE Series 2000*.

If the CIM/CIU 110 is unable to communicate with the pump for 1 second, the df_elect_failure bit is set. The fault is visible on the node object as well. See section *14. Details of the node object's functional block*. This fault will not be visible in the controller.

Example:

nvoSPumpFault_1

nvoSPumpFault_2

nvoSPumpFault_3.

Pump faults, TPE Series 1000/2000, CME, CRE and UPE Series 2000

Bit name	Description	Corresponding warning/alarm on the R100
sf_voltage_low	Supply voltage is too low.	Undervoltage (40) Undervoltage transient (41) Cut-in fault (dV/dt)(42) Inrush fault (155)
sf_voltage_high	Supply voltage is too high.	Overvoltage (32)
sf_phase	Power missing phase.	Electronic DC-link protection activated (ERP) (14)
sf_no_fluid	No liquid in pump.	Dry running (57)
sf_press_low	System pressure is too low.	-
sf_press_high	System pressure is too high.	Turbine operation (29)
df_motor_temp	Motor temperature is too high.	Overtemperature (64) Motor temperature 1 (65) Temperature too high, internal frequency converter module (t_m) (67)
df_motor_failure	Motor has fatal failure.	External fault signal (3) Too many restarts (from standby mode per 24 hours) (4) Too many hardware shutdowns (short standbys per minute) (7) Overload (48) Overcurrent (i_line, i_dc, i_mo) (49) Motor protection function, general shutdown (mpf) (50) Motor protection function, 3 sec. limit (54) Motor current protection activated (MCP) (55) Underload (56)
df_pump_blocked	Pump is blocked.	Blocked motor/pump (51)
df_elect_temp	Electronic temperature is too high.	-
df_elect_failure_nf	Electronic non-fatal failure.	**Note:** Warning codes only! Hardware fault, type 1 (72) Hardware shutdown (HSD) (73) Internal communication fault (76) Communication fault, twin-head pump (77) Hardware fault, type 2 (80) Verification error, FE parameter area (EEPROM) (83) Verification error, BE parameter area (EEPROM) (85) Electronic rectifier protection activated (ERP) (105) Electronic inverter protection activated (EIP) (106) Communication fault, internal frequency converter module (156)
df_elect_failure	Electronic fatal failure.	**Note:** Alarm codes only! Leakage current (1) Hardware fault, type 1 (72) Hardware shutdown (HSD) (as G10) (73) Internal communication fault (76) Communication fault, twin-head pump (77) Hardware fault, type 2 (80) Verification error, BE parameter area (EEPROM) (85) Electronic rectifier protection activated (ERP) (105) Electronic inverter protection activated (EIP) (106) Communication fault, internal frequency converter module (156)
df_sensor_failure	Sensor failure.	Sensor fault (as G10) (88) Signal fault, (feedback) sensor 1 (89) Setpoint signal outside range (96)

When transmitted

This value is transmitted immediately when one of the bits has changed.

Example:

nvoSPumpStatus_1

nvoSPumpStatus_2

nvoSPumpStatus_3.

13.4 Pump status, diagnostic information

`network output SNVT_dev_status nvoSPumpStatus;`

This network variable output provides detailed diagnostic information on the status of the pump controller.

Pump status, diagnostic information

Bit name	Description
device_fault	See section *12.23 Pump fault status* for detailed information.
supply_fault	No liquid in pump, supply voltage too high/low, etc. See section *12.23 Pump fault status* for detailed information.
local_control	The pump has been set to local mode by hardware override (push-buttons on pump, external STOP or with the R100). If the pump is controlled manually from the controller, this bit is not set.
running	The pump is running.

When transmitted

This value is transmitted immediately when it has changed.

Example:

nvoSPumpStatus_1

nvoSPumpStatus_2

nvoSPumpStatus_3.

14. Details of the node object's functional block

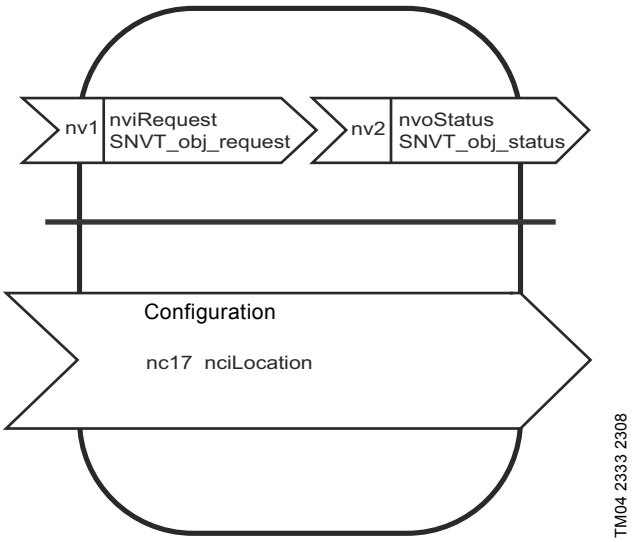


Fig. 14 Functional block of node object

14.1 Object request

`network input SNVT_obj_request nviRequest;`

This network variable input provides the function to request a particular mode for a particular object within a node.

Valid range

The following values are supported.

Object request

No	Request	Description
0	RQ_NORMAL	Enters the normal state. Cancels disabled state.
1	RQ_DISABLED	Disables functional block.
2	RQ_UPDATE_STATUS	Reports status of functional block (refer to nvoStatus).
5	RQ_REPORT_MASK	Reports status mask.
7	RQ_ENABLE	Enables functional block.
9	RQ_CLEAR_STATUS	Clears bits of nvoStatus after RQ_REPORT_MASK request.
10	RQ_CLEAR_ALARM	Resets alarms in the controller.

14.2 Object status

`network output SNVT_obj_status nvoStatus;`

This network variable output reports the status of any object within a node.

Object status

Status bit	Description
invalid_id	The requested ID is not implemented in this node.
invalid_request	Request for unimplemented function.
disabled	The functional block is currently disabled.
electrical_fault	Electrical fault detected in pump.
unable_to_measure	The CIM/CIU 110 is unable to communicate with the controller.
manual_control	The controller has been set to local control and is not controlled by the CIM/ CIU 110. This mode is set via the operator display.
in_alarm	The controller has an alarm.
report_mask	The node is reporting mask.

14.3 Location label

`network input config SNVT_str_asc nciLocation;`

This network configuration property input can be used to provide the location of the functional block (or device).

Valid range

Any NULL-terminated ASCII string of 31 bytes total length (including NULL).

Default value

The default value is an ASCII string containing all zeros ("\0").

15. Manufacturer-specific variables

Grundfos command

```
network input UNVT_GF_cmd nviGrundfosCmd;
```

This manufacturer-specific network variable input provides the function to request a particular information string from the controller. This string contains information about node software version and date, which can be used when downloading new software to the node. The result from this command can be seen in nvoGrundfosInfo.

Valid range

No	Request	Description
0	GF_NO_CMD	No command
1	GF_PRODUCT_VER	Product version (not used)
2	GF_PRODUCT_INFO	Product info
3	GF_SOFTWARE_VERSION	Software version
4	GF_SOFTWARE_DATE	Release date of software
5	GF_SOFTWARE_DEVELOPERS	Initials of software developers

15.1 Grundfos info

```
network output SNVT_str_asc nvoGrundfosInfo;
```

This manufacturer-specific network variable output provides the function to get an information string from the controller. This string contains information about node software version and date, which can be used when downloading new software to the node. This string is the result from nviGrundfosCmd.

Valid range

Any NULL-terminated ASCII string of 31 bytes total length.

15.2 Device resource files

The CIM/CIU 110 contains UNVTs and UCPTs. Therefore, Grundfos is supplying DRFs. If the DRFs are used, the right formatting and type definition will be achieved.

The DRFs can be found on the CD-ROM with this functional profile.

The files can be installed by copying them to for example

C:\LONWORKS\TYPES\USER\GRUNDFOS\

Then use the ldrfcat.exe program to add the files.

Note For further information about how to install DRFs, see Echelon documentation.

The following UNVTs and UCPTs are supported by the DRF: UNVT_GF_cmd.

16. Sensor ranges

16.1 Positive sensor ranges

The normal calculation of effective setpoint from nviPumpSetpoint is based on the standard LonMark pumpController profile (8120) that operates exclusively with sensor ranges having

sensor maximum value > sensor minimum value >= 0

Effective setpoint is calculated from the following formula:

effectiveset = nviPumpSetpoint x sensormax

When positive sensor ranges are used, bit 1 of nvoSystemStatus is 0.

Example

Sensor: 10 to 25 bar.

nviPumpSetpoint = 60 %.

effectivesetpoint = nviPumpSetpoint x sensormax = 60 % x 25 bar = 15 bar.

16.2 Negative sensor ranges

If a sensor with a negative range is used, or the sensor range crosses 0 (sensor max. > = 0 and sensor min. < 0), a different formula is used.

Use this formula:

effectivesetpoint = nviPumpSetpoint x (sensormax - Sensormin) + sensormin

When negative or partly negative sensor ranges are used, bit 1 of nvoSystemStatus is 1.

Example 1

Sensor: -10 °C to 30 °C.

nviPumpSetpoint = 40 %.

effectivesetpoint ≙ nviPumpSetpoint x (sensormax - sensormin) ± sensormin ≙ 40 % x (30 °C - (10 °C)) ± (-10 °C) ≙
40 % x 40 °C - 10 °C ≙ 16 °C - 10 °C ≙ 6 °C.

Example 2

Sensor: -80 °C to -20 °C.

nviPumpSetpoint = 50 %.

effectivesetpoint ≙ nviPumpSetpoint x (sensormax - sensormin) ± sensormin ≙ 50 % x (-20 °C - (80 °C)) ± (-80 °C) ≙
50 % x 60 °C - 80 °C ≙ 30 °C - 80 °C ≙ 50 °C.

17. Fault finding

Faults in a CIM 110 can be detected by observing the status of the service LED (LED1) and the LED for internal communication (LED2). See the table below.

When the CIM 110 is working properly on the LON network, the yellow service LED (LED1) is permanently off.

When a controller is connected to the CIM 110, the LED for internal communication (LED2) is permanently green.

Note When the CIM/CIU 110 is connected to the power supply, the yellow service LED (LED1) will flash once.

CIM 110 fitted in the controller

Fault (LED status)	Possible cause	Remedy
1. The service LED (LED1) remains off when the power supply is connected.	a) No power supply to the CIU 110.	Check the power supply to the CIU 110.
	b) The CIM 110 is defective.	Replace the CIM 110.
2. The service LED (LED1) is permanently on.	a) The CIM 110 is defective.	Replace the CIM 110.
3. The service LED (LED1) flashes when the power supply is connected to the CIM 110, turns off, turns on again and remains permanently on.	a) The CIM 110 has no application software (application-less).	Try to download application software via a LON installation tool such as LonMaker.
	b) The CIM 110 is defective.	Replace the CIM 110.
4. The service LED (LED1) flashes every second.	a) The CIM 110 has not been installed.	Install the CIM 110 by means of a LON installation tool such as LonMaker.
5. The controller does not react to changes of settings, and the readout from the LON network is incorrect. The LED for internal communication (LED2) is permanently red.	a) The CIM 110 does not support the controller connected.	Contact the nearest Grundfos company.
	b) The LON application may be wrong, for instance CIM 100 software where CIM 110 software is required.	Download correct software via a LON installation tool such as LonMaker.
6. The controller does not react to changes of settings, and the readout from the LON network is incorrect. The LED for internal communication (LED2) is flashing red.	a) The cable between the CIM 110 and the controller is connected incorrectly or damaged.	Connect the cable correctly, or replace the cable.

CIM 110 fitted in the CIU 110

Fault (LED status)	Possible cause	Remedy
1. The service LED (LED1) remains off when the power supply is connected.	a) No power supply to the CIU 110.	Check the power supply to the CIU 110.
	b) The CIM 110 is defective.	Replace the CIM 110.
2. The service LED (LED1) is permanently on.	a) The CIM 110 is defective.	Replace the CIM 110.
3. The service LED (LED1) flashes when the power supply is connected to the CIM 110, turns off, turns on again and remains permanently on.	a) The CIM 110 has no application software (application-less).	Try to download application software via a LON installation tool such as LonMaker.
	b) The CIM 110 is defective.	Replace the CIM 110.
4. The service LED (LED1) flashes every second.	a) The CIM 110 has not been installed.	Install the CIM 110 by means of a LON installation tool such as LonMaker.
5. The controller does not react to changes of settings, and the readout from the LON network is incorrect. The LED for internal communication (LED2) is permanently red.	a) The CIM 110 does not support the controller connected.	Contact the nearest Grundfos company.
	b) The LON application may be wrong, for instance CIM 100 software where CIM 110 software is required.	Download correct software via a LON installation tool such as LonMaker.
6. The controller does not react to changes of settings, and the readout from the LON network is incorrect. The LED for internal communication (LED2) is flashing red.	a) The cable between the CIM 110 and the controller is connected incorrectly or damaged.	Connect the cable correctly, or replace the cable.

18. Grundfos alarm and warning codes

This is a complete list of alarm and warning codes for Grundfos products. For the codes supported by booster systems, see the Alarms and warnings section.

Code	Description	Code	Description	Code	Description
1	Leakage current	84	Memory access error	181	Signal fault, PTC sensor (short-circuited)
2	Missing phase	85	Verification error, BE parameter area (EEPROM)	182	Signal fault, bearing temperature sensor (Pt100), bottom bearing
3	External fault signal	86	Fault (add-on) I/O module	183	Signal fault, extra temperature sensor
4	Too many restarts	88	Sensor fault	184	Signal fault, general-purpose sensor
5	Regenerative braking	89	Signal fault, (feedback) sensor 1	185	Unknown sensor type
6	Mains fault	90	Signal fault, speed sensor	186	Signal fault, power meter sensor
7	Too many hardware shutdowns	91	Signal fault, temperature sensor 1	187	Signal fault, energy meter
8	PWM switching frequency reduced	92	Calibration fault, (feedback) sensor	188	Signal fault, user-defined sensor
9	Phase sequence reversal	93	Signal fault, sensor 2	189	Signal fault, level sensor
10	Communication fault, pump	94	Limit exceeded, sensor 1	190	Limit exceeded, sensor 1 (e.g. alarm level in WW application)
11	Water-in-oil fault (motor oil)	95	Limit exceeded, sensor 2	191	Limit exceeded, sensor 2 (e.g. high level in WW application)
12	Time for service (general service information)	96	Setpoint signal outside range	192	Limit exceeded, sensor 3 (e.g. overflow level in WW application)
13	Moisture alarm, analog	97	Signal fault, setpoint input	193	Limit exceeded, sensor 4 (e.g. low level in WW/tank filling application
14	Electronic DC-link protection activated (ERP)	98	Signal fault, input for setpoint influence	194	Limit exceeded, sensor 5
15	Communication fault, main system (SCADA)	99	Signal fault, input for analog setpoint	195	Limit exceeded, sensor 6
16	Other	100	RTC time synchronisation with GSM occured	196	Operation with reduced efficiency
17	Performance requirement cannot be met	102	Dosing pump not ready	197	Operation with reduced pressure
18	Commanded alarm standby (trip)	103	Emergency stop	198	Operation with increased power consumption
19	Diaphragm break (dosing pump)	104	Software shutdown	199	Process out of range (monitoring/ estimation/calculation/control)
20	Insulation resistance low	105	Electronic rectifier protection activated (ERP)	200	Application alarm
21	Too many starts per hour	106	Electronic inverter protection activated (EIP)	201	External sensor input high
22	Moisture switch alarm, digital	110	Skew load, electrical asymmetry	202	External sensor input low
23	Smart trim gap alarm	111	Current asymmetry	203	Alarm on all pumps
24	Vibration	112	Cos φ too high	204	Inconsistency between sensors
25	Setup conflict	113	Cos φ too low	205	Level float switch sequence inconsistency
26	Load continues even if the motor has been switched off	114	Motor heater function activated (frost protection)	206	Water shortage, level 1
27	External motor protector activated (e.g. MP 204)	115	Too many grinder reversals or grinder reversal attempt failed	207	Water leakage
28	Battery low	116	Grinder motor over temperature	208	Cavitation
29	Turbine operation (impellers forced backwards)	118	Signal fault, hydrogen sulfide H2S sensor	209	Non-return valve fault
30	Change bearings (specific service information)	119	Signal fault, analog input AI4	210	High pressure
31	Change varistor(s) (specific service information)	120	Auxiliary winding fault (single-phase motors)	211	Low pressure
32	Overvoltage	121	Auxiliary winding current too high (single-phase motors)	212	Diaphragm tank precharge pressure out of range
33	Soon time for service (general service information)	122	Auxiliary winding current too low (single-phase motors)	213	VFD not ready
34	No priming water	123	Start capacitor, low (single-phase motors)	214	Water shortage, level 2

Code	Description	Code	Description	Code	Description
35	Gas in pump head, deaerating problem	124	Run capacitor, low (single-phase motors)	215	Soft pressure build-up time-out
36	Discharge valve leakage	125	Signal fault, outdoor temperature sensor	216	Pilot pump alarm
37	Suction valve leakage	126	Signal fault, air temperature sensor	217	Alarm, general-purpose sensor high
38	Vent valve defective	127	Signal fault, shunt relative pressure sensor	218	Alarm, general-purpose sensor low
39	Valve stuck/defective	128	Strainer clogged	219	Pressure relief not adequate
40	Undervoltage	144	Motor temperature 3 (Pt100, t_mo3)	220	Fault, motor contactor feedback
41	Undervoltage transient	145	Bearing temperature high (Pt100), in general or top bearing	221	Fault, mixer contactor feedback
42	Cut-in fault (dV/dt)	146	Bearing temperature high (Pt100), middle bearing	222	Time for service, mixer
45	Voltage asymmetry	147	Bearing temperature high (Pt100), bottom bearing	223	Maximum number of mixer starts per hour exceeded
48	Overload	148	Motor bearing temperature high (Pt100) in drive end (DE)	224	Pump fault (due to auxiliary component or general fault)
49	Overcurrent (i_line, i_dc, i_mo)	149	Motor bearing temperature high (Pt100) in non-drive end (NDE)	225	Communication fault, pump module
50	Motor protection function, general shutdown (MPF)	150	Fault (add-on) pump module	226	Communication fault, I/O module
51	Blocked motor/pump	151	Fault, display (HMI)	227	Combi event
52	Motor slip high	152	Communication fault, add-on module	228	Night flow max. limit exceeded
53	Stalled motor	153	Fault, analog output	229	Water on floor
54	Motor protection function, 3 sec. limit	154	Communication fault, display	230	Network alarm
55	Motor current protection activated (MCP)	155	Inrush fault	231	Ethernet: No IP address from DHCP server
56	Underload	156	Communication fault, internal frequency converter module	232	Ethernet: Auto-disabled due to misuse
57	Dry running	157	Real-time clock out of order	233	Ethernet: IP address conflict
58	Low flow	158	Hardware circuit measurement fault	234	Backup pump alarm
59	No flow	159	CIM fault (Communication Interface Module)	235	Gas detected
60	Low input power	160	GSM modem, SIM card fault	236	Pump 1 fault
64	Overtemperature	161	Sensor supply fault, 5 V	237	Pump 2 fault
65	Motor temperature 1 (t_m or t_mo or t_mo1)	162	Sensor supply fault, 24 V	238	Pump 3 fault
66	Temperature, control electronics (t_e)	163	Measurement fault, motor protection	239	Pump 4 fault
67	Temperature too high, internal frequency converter module (t_m)	164	Signal fault, LiqTec sensor	240	Lubricate bearings (specific service information)
68	External temperature/water temperature (t_w)	165	Signal fault, analog input 1	241	Motor phase failure
69	Thermal relay 1 in motor (e.g. Klixon)	166	Signal fault, analog input 2	242	Automatic motor model recognition failed
70	Thermal relay 2 in motor (e.g. thermistor)	167	Signal fault, analog input 3	243	Motor relay has been forced (manually operated/commanded)
71	Motor temperature 2 (Pt100, t_mo2)	168	Signal fault, pressure sensor	244	Fault, On/Off/Auto switch
72	Hardware fault, type 1	169	Signal fault, flow sensor	245	Pump continuous runtime too long
73	Hardware shutdown (HSD)	170	Signal fault, water-in-oil (WIO) sensor	246	User-defined relay has been forced (manually operated/commanded)
74	Internal supply voltage too high	171	Signal fault, moisture sensor	247	Power-on notice (device/system has been switched off)
75	Internal supply voltage too low	172	Signal fault, atmospheric pressure sensor	248	Fault, battery/UPS
76	Internal communication fault	173	Signal fault, rotor position sensor (Hall sensor)	249	User-defined event 1
77	Communication fault, twin-head pump	174	Signal fault, rotor origo sensor	250	User-defined event 2

Code	Description	Code	Description	Code	Description
78	Fault, speed plug	175	Signal fault, temperature sensor 2 (t_mo2)	251	User-defined event 3
79	Functional fault, add-on module	176	Signal fault, temperature sensor 3 (t_mo3)	252	User-defined event 4
80	Hardware fault, type 2	177	Signal fault, Smart trim gap sensor	253	SMS data from DDD sensor not received within time
81	Verification error, data area (RAM)	178	Signal fault, vibration sensor	254	Inconsistent data model
82	Verification error, code area (ROM, FLASH)	179	Signal fault, bearing temperature sensor (Pt100), general or top bearing		
83	Verification error, FE parameter area (EEPROM)	180	Signal fault, bearing temperature sensor (Pt100), middle bearing		

Subject to alterations.

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